PPHB
ENERGY INVESTMENT BANKING

MUSINGS FROM THE OIL PATCH

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Note: *Musings from the Oil Patch reflects an eclectic collection of stories and analyses dealing with issues and developments within the energy industry that I feel have potentially significant implications for executives operating and planning for the future. The newsletter is published every two weeks, but periodically events and travel may alter that schedule. As always, I welcome your comments and observations.* Allen Brooks

The Auto Industry, The EV Revolution And Fuel Markets

While BP plc projects that the global auto fleet will grow from 900 million vehicles in 2015 to 1.8 billion in 2035, Exxon Mobil Corp. only sees the global vehicle fleet reaching 1.8 billion units five years later in 2040

One of the key tenets of long-term energy market forecasts is the continuing role vehicles with internal combustion engines play in the world despite market share gains by electric vehicles and the impact of changing consumer mobility models. While BP plc (BP-NYSE) projects that the global auto fleet will grow from 900 million vehicles in 2015 to 1.8 billion in 2035, Exxon Mobil Corp. (XOM-NYSE) only sees the global vehicle fleet reaching 1.8 billion units five years later in 2040. ExxonMobil believes that there are one billion vehicles currently on the world's roads, some 100 million more than BP estimates. So two major oil companies with departments of economists studying the energy market and predicting its future are 100 million vehicles apart, some 10% or more of the world's fleet size. Is that difference meaningful? The different forecast starting points may impact projections for fuel consumption at times as the pace of the impact of EVs and mobility changes can be different.

Assuming the two fleets have the same fuel efficiency ratings, then more fuel will be needed under the BP forecast than under ExxonMobil's

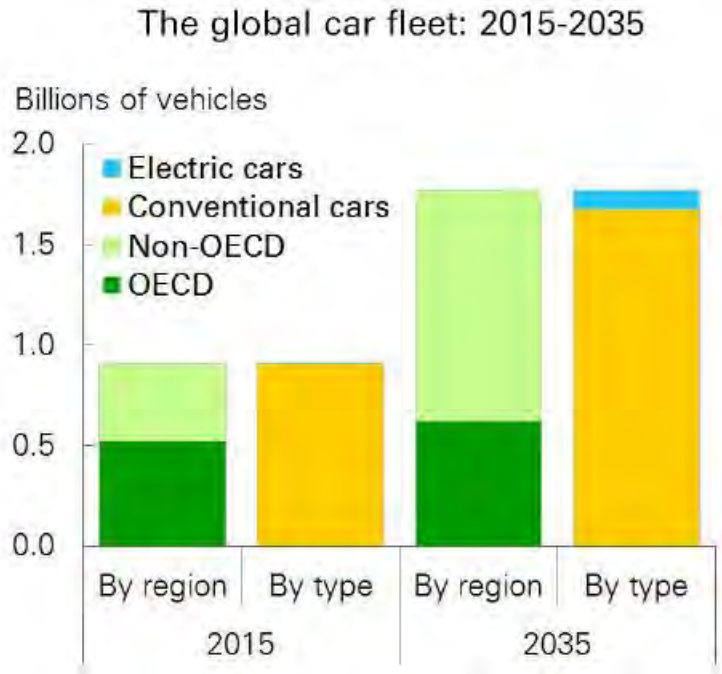
As is often the case with long-term energy market forecasts, the presentations and disclosures of the data fail to provide comparable numbers for comparisons. The differences in the starting points for the world's vehicle fleet between the two company forecasts is material. The fleet grows to 1.8 billion vehicles in either 19 years (BP), or 24 years (ExxonMobil). Since BP's forecast starts from a base of 900 million units, its growth rate for the fleet is faster than that of ExxonMobil who begins from a base that is 100 million units larger and needs five additional years to reach the 1.8 billion unit number. Assuming the two fleets have the same fuel efficiency ratings, then more fuel will be needed under the BP forecast than under ExxonMobil's, even with the latter forecast starting with 100 million more vehicles. Regardless of the numbers, the key point is that both predictions have the global automobile fleet growing substantially and that they will largely be powered by gasoline.

Besides the difference in the number of vehicles at the starting point and the ending points for reaching 1.8 billion units, there seems to be a meaningful difference in the eventual compositions of the fleets. The charts in Exhibits 1 and 2 (next page) show the respective company forecasts for fleet composition. Unfortunately, BP only divides its future fleet composition between conventional and electric vehicles. ExxonMobil provides a more detailed fleet composition breakdown encompassing conventional, electric, full hybrid, diesel and natural gas powered vehicles.

The additional vehicle types in the ExxonMobil forecast will have an impact on the amount of gasoline consumed

In looking at the 2035 forecasts for both companies, it appears as the amount of the fleet represented by electric vehicles is similar. But the additional vehicle types in the ExxonMobil forecast will have an impact on the amount of gasoline consumed as both diesel and natural gas powered vehicles do not use gasoline. Whether, at the end of the day, this additional detail of the fleet composition materially impacts the forecast for the amount of petroleum, let along the amount of hydrocarbons, needed to power the global vehicle fleet is questionable.

Exhibit 1. BP Sees Global Car Fleet Doubling By 2035

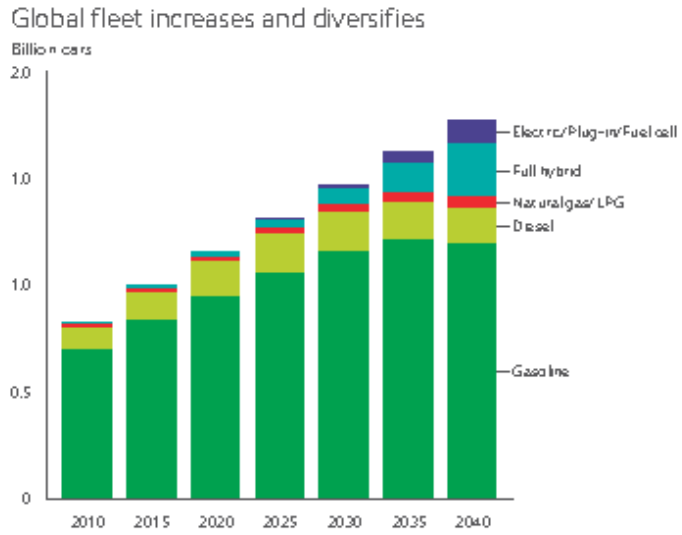


Source: BP

ExxonMobil suggests that it sees average fleet fuel efficiency increasing from about 30 miles per gallon to nearly 50 mpg in 2040

Probably the more important consideration in estimating the future fuel needs for the global transportation sector is the fuel efficiency performance of the future fleet. ExxonMobil suggests that it sees average fleet fuel efficiency increasing from about 30 miles per gallon to nearly 50 mpg in 2040. This improved fuel efficiency more than offsets the growth in vehicle miles traveled, which ExxonMobil

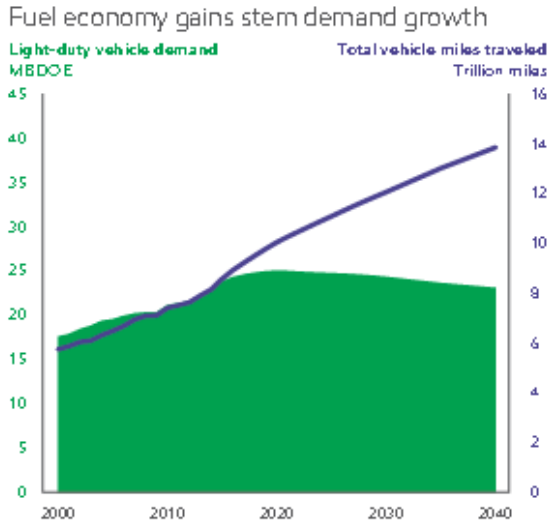
Exhibit 2. How Exxon Sees Future Fleet



Source: ExxonMobil

projects will continue to grow at about the same rate as in the early years of this century before the explosion in crude oil prices and the impact of the 2008-2009 financial crisis and recession hit driving.

Exhibit 3. How Fuel Efficiency Offsets More Driving



Source: ExxonMobil

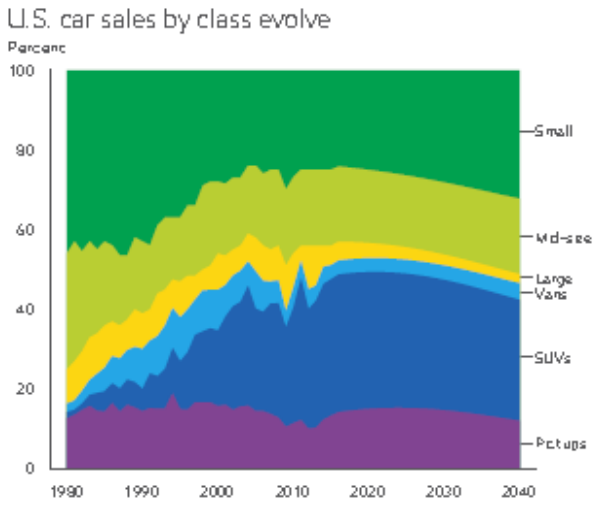
ExxonMobil sees divergent trends between vehicle miles traveled and fuel consumption

A key reason why ExxonMobil sees divergent trends between vehicle miles traveled and fuel consumption is the shift by consumers toward smaller vehicles in the future. ExxonMobil presented a graph in their energy outlook showing the mix of vehicles by size/type in the future U.S. vehicle fleet. As seen in

Starting about 2020, both pickups and sport utility vehicles peak in sales as consumers shift to smaller vehicles

Exhibit 4, starting about 2020, both pickups and sport utility vehicles peak in sales as consumers shift to smaller vehicles driven by both projected fuel cost increases and the increased urbanization of America. We know that throughout the rest of the world, smaller vehicles already are the norm as roads and cities are less accommodating of larger vehicles.

Exhibit 4. How Shift To Small Cars Alters Fleet Makeup



Source: ExxonMobil

BP lays out their forecast showing that global gasoline consumption totaled 19 million barrels per day in 2015 and winds up at 23 million barrels a day in 2035

What is the impact of these various trends on future gasoline consumption? BP lays out their forecast showing that global gasoline consumption totaled 19 million barrels per day in 2015 and winds up at 23 million barrels a day in 2035. The increase comes from 23 million more barrels a day due to increased vehicle miles traveled, which is offset by 17 million barrels a day from improved vehicle fuel efficiency and 0.2 million barrels a day from the switch to natural gas powered vehicles and 1.2 million barrels a day from the increased penetration of electric vehicles in the fleet.

In the case of ExxonMobil's forecast, it sees gasoline consumption peaking in the early 2020s and then declining

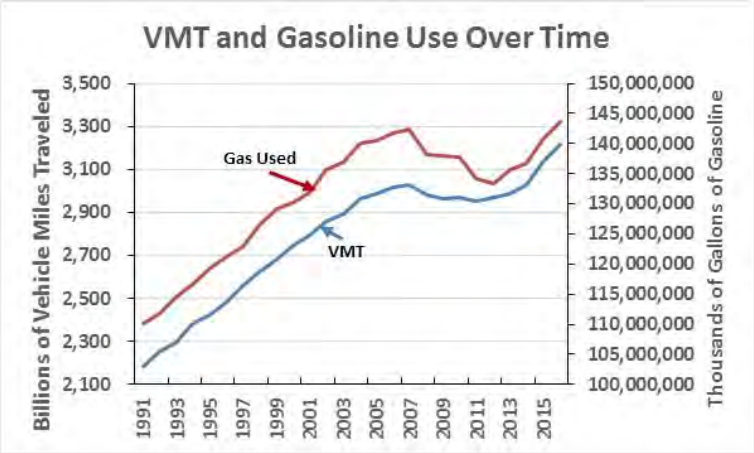
In the case of ExxonMobil's forecast, it sees gasoline consumption peaking in the early 2020s and then declining by an estimated 10% by 2040. In the company's commentary on the graph showing that trajectory, ExxonMobil states that two-thirds of the reduction comes from improved vehicle fuel efficiency with the remainder due to the adoption of electric and full hybrid vehicles.

The difference between the ExxonMobil and BP forecasts is stark in that the former sees gasoline use declining after the 2020 while BP sees gasoline consumption increasing. The difference in longer term outlooks for the fuel market prompted us to examine what has been happening in the U.S. vehicle and fuels markets.

Researchers spent a lot of time trying to determine whether America's love affair with automobiles had ended

After peaking in 2007, U.S. vehicle miles traveled either declined or went sideways for the next four years before resuming their upward trend in 2012. During that time, researchers spent a lot of time trying to determine whether America's love affair with automobiles had ended. Reasons for the decline in vehicle miles traveled were attributed to the financial crisis and recession with its job losses and declines in workers' commuting. There were extensive investigations of the impact of the internet on socially-related driving and shopping patterns. There was also an issue of a change in attitudes toward vehicles by Millennials as data showed teenagers delaying getting their drivers' licenses and fewer young people owning vehicles. How much of the changes were economically-driven versus socially-driven was impossible to tell with any degree of accuracy.

Exhibit 5. Gasoline Consumption Tracks Vehicle Miles



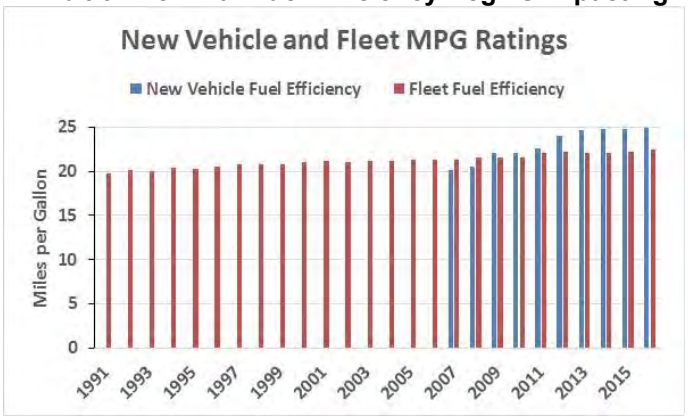
Source: FHWTA, EIA, PPHB

It wasn't until 2012 that the fuel efficiency rating of new cars significantly rose above the average for the entire fleet

From the transportation market viewpoint, the decline in vehicle miles traveled also resulted in a decline in gasoline consumption. In fact, the decline in gasoline volumes was more dramatic than the decline in vehicle miles traveled, which is probably explained by the timing of significant improvements in vehicle fuel efficiency shown in Exhibit 6. Based on reports of annual new vehicle sales as well as calculations of annual vehicle scrappage the changes in the number of vehicles registered each year, the annual size of the U.S. vehicle fleet can be estimated. Based on the number of vehicle miles traveled each year and the amount of gasoline consumed, we can estimate the annual vehicle fuel efficiency rating. Beginning in 2007, the Transportation Research Institute at the University of Michigan began tracking the sales-weighted fuel efficiency of new vehicles sold. As can be seen from the chart, it wasn't until 2012 that the fuel efficiency rating of new cars significantly rose above the average for the entire fleet.

It is not surprising that we are approaching the 25-miles-per-gallon rating for new car sales given the higher fuel efficiency ratings

Exhibit 6. New Car Fuel Efficiency Begins Impacting MPG

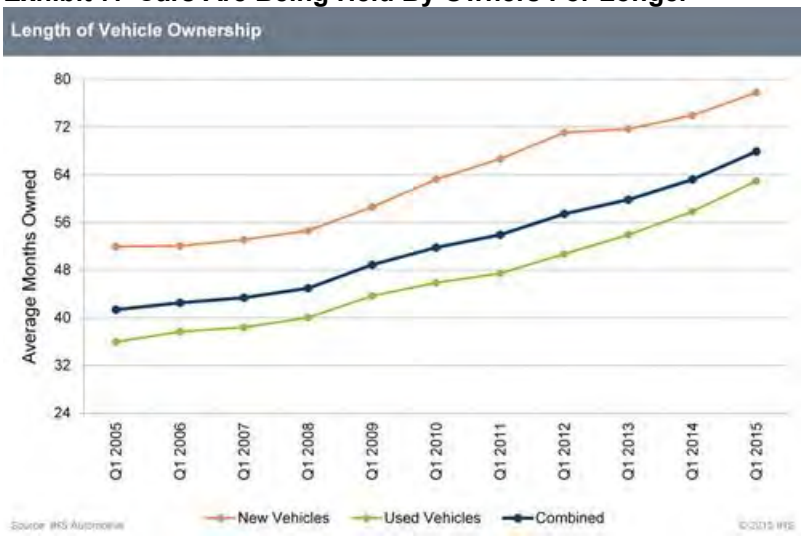


Source: IHS Automotive, Michigan Transportation Institute, PPHB

Another factor that has held back greater improvements in overall fuel efficiency has been the gradual aging of the fleet

agreed to by the auto makers and the Obama administration. The higher fleet fuel ratings reported in recent years have come despite low gasoline prices that have stimulated the sales of pickups and sport utility vehicles with notoriously less efficient fuel performance ratings. Another factor that has held back greater improvements in overall fuel efficiency has been the gradual aging of the fleet. The improved quality of late model vehicles has encouraged their owners to hold onto them longer. That pattern is both a reflection of the improved quality of vehicles but also the escalating cost of new vehicles driven by increased safety equipment and mandates. Yes, it may be nice to have the latest software versions and safety devices, but when measured against the incremental cost in a world where Middle Class workers are suffering from very low increases in wages, people are opting to keep their vehicles longer, even if it means increased repair costs.

Exhibit 7. Cars Are Being Held By Owners For Longer



Source: IHS Automotive

To offset vehicle cost increases, buyers have been lengthening the term of car loans assumed to finance new vehicle purchases

According to IHS Research, the average age of a vehicle on U.S. roads in 2015 was up to 11.5 years. In 2009, the mean age of vehicles was 9.4 years. Some of that increase was due to the fallout from the 2009 recession, but increasingly it is coming because of improved vehicle quality and increased vehicle costs. To offset vehicle cost increases, buyers have been lengthening the term of car loans assumed to finance new vehicle purchases. According to Debt.org, the average length of a car loan in 2010 was 62 months, or just over five years. In 2015, the term length was up to 67 months, or nearly half a year longer. "The trend is going even longer with 30 percent of car loans now stretched between 72 and 84 months," says Debt.org. "The average amount financed in 2015 was $28,711 with average monthly payments of $485, a record high for both length of loan and amount financed." In some cases, car loans are being extended to 96 months, or eight years long. While longer loans are more budget-friendly, they increase the amount of interest expense a buyer has to pay over the term of the loan, which often creates problems for car owners by putting them "upside down," meaning they owe more on the loan than the vehicle is worth as either a trade-in or used car sale. This can create a debt spiral issue if and when car owners wish to acquire a new vehicle.

IHS predicted in early 2016 that the average age of the vehicle fleet would increase to 11.6 years, up from 2015's 11.5 year figure, but not reach 11.7 years until 2018

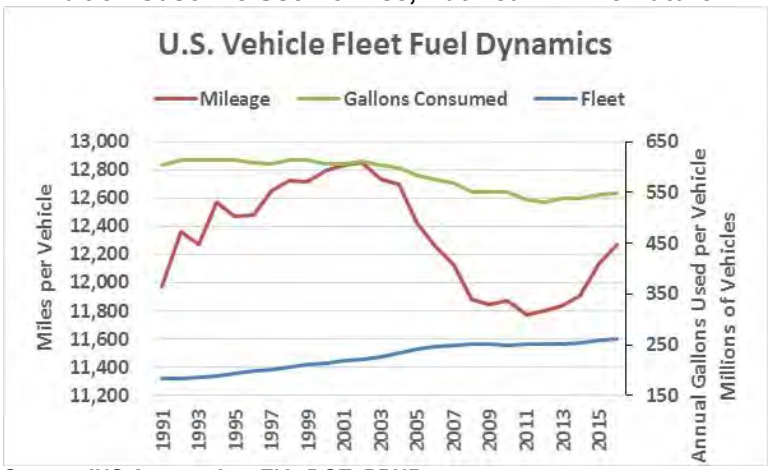
We have crystalized several U.S. vehicle market dynamics over the past 25 years in one chart to show how things have changed, and possibly to highlight how they might impact the market of the future. After years of fleet growth prior to the financial crisis and recession that sapped growth, we now see the vehicle fleet growing again. The growth rate, however, is at a slower pace than experienced in those earlier years. That reflects the lengthening of vehicle ownership periods. Although the size of the light vehicle fleet is at a new peak, it is projected to continue growing, albeit slowly, as new car sales continue to outpace scrapping. In 2015, new car sales outpaced scrapping by 42%, the highest rate since IHS began tracking the statistics. IHS predicted in early 2016 that the average age of the vehicle fleet would increase to 11.6 years, up from 2015's 11.5 year figure, but not reach 11.7 years until 2018.

In the first quarter of 2015, the average length of ownership for a new vehicle was 77.8 months, an increase of nearly 26 months since the first quarter of 2006

According to IHS Automotive, in the first quarter of 2015, the average length of ownership for a new vehicle was 77.8 months, an increase of nearly 26 months since the first quarter of 2006. For used cars, the ownership period was 63 months, up just over 25 months over the past decade. All of these metrics suggest that unless new car sales plummet or vehicle scrapping steps up materially, the fleet will continue to increase, but likely at the more pedestrian pace of recent years.

As also shown in Exhibit 8, the miles traveled per vehicle in a year, after falling steadily from 2001 to 2011, has shown a steady increase. That increase has come while gasoline prices were both high and low, as crude oil prices soared well above $100 a barrel, but then declined to the $30s and $40s a barrel.

Exhibit 8. Gasoline Use To Rise, But Peak In The Future



Source: IHS Automotive, EIA, DOT, PPHB

The pattern of gasoline consumption reflects the improved fuel efficiency of recent vintage vehicles

What is interesting is that even while mileage was rising in the 1990s, the annual amount of gasoline used per vehicle was slowly declining. The volume fell more sharply during the years when mileage was declining, but even with mileage climbing, gasoline consumption is rising very slowly. Obviously, the pattern of gasoline consumption reflects the improved fuel efficiency of recent vintage vehicles, a trend likely to continue given the more fuel efficient vehicles entering the fleet, even with more pickups and SUVs being sold.

We see a potential peak in gasoline consumption in the future

As we assess the dynamics of the global vehicle market, we find ourselves siding increasingly with ExxonMobil's view. In other words, we see a potential peak in gasoline consumption in the future. Will it come in 2020 or the early years of that decade, or will be later? The growing push for gasoline- and diesel-free vehicles combined with any potential breakthroughs in battery technology will likely sap the growth of the gasoline market.

last week, Toyota and Honda Motor Company announced a joint venture in Michigan to produce advanced hydrogen fuel cell systems for their offerings in California

Toyota Motors' (TM-NYSE) success in developing hybrid vehicle technology is an important lesson as the company focuses more intensely on developing hydrogen fuel cell cars. In fact, last week, Toyota and Honda Motor Company (HMC-NYSE) announced a joint venture in Michigan to produce advanced hydrogen fuel cell systems for their offerings in California. This is a promising technology that could create another non-polluting vehicle market niche. Developments such as this will continue to shape the vehicle fleet of the future and impact fuel dynamics. We will continue to monitor these trends with an eye to try to gauge whether BP or ExxonMobil have read the tea leaves better.

Are The Speculators Right About The Oil Price Direction?

Traders in crude oil futures held the largest net long (bullish) position in 10 years a week ago

According to data from the Commodity Futures Trading Commission (CFTC), traders in crude oil futures held the largest net long (bullish) position in 10 years a week ago. A long position represents an obligation by the trader to buy 1,000 barrels of oil at a fixed price. Likewise, a short position is an obligation of the trader to sell a similar volume of oil at the fixed price. A holder of a long position is betting that the oil price will rise in the future so he can then sell his contract at a profit, while a trader holding a short position is betting the price of oil will fall and the position can be closed out by purchasing a long contract at the lower price generating a profit on the overall transaction.

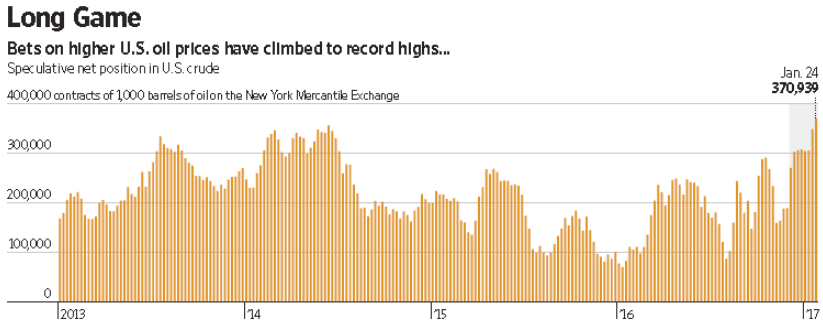
There were 420,000 long contracts held by traders, representing 420 million barrels of oil, or nearly as much oil as would be contained in all the crude oil storage tanks in the United States

The CFTC data for the week of January 24, 2017, showed that there were 420,000 long contracts held by traders, representing 420 million barrels of oil, or nearly as much oil as would be contained in all the crude oil storage tanks in the United States. Based on the November 2016 report on petroleum storage and storage capacity issued by the U.S. Energy Information Administration (EIA) based on September 2016 survey data, there was total storage capacity of 452.8 million barrels, excluding the storage capacity of the Strategic Petroleum Reserve, which adds an additional 727.0 million barrels of storage to the nation's total.

The January 24th position has spiked up and surpassed the previous high in long contract holdings established in the late spring of 2014

To place in perspective the significance of the bullish bet by traders on the future for crude oil prices, the *Wall Street Journal,* a little over a week ago, published a chart of the CFTC weekly traders' holdings since the start of 2013. The chart shows how the January 24th position has spiked up and surpassed the previous high in long contract holdings established in the late spring of 2014. That peak marked the then highest long position of traders, surpassing a peak set near the end of the first quarter of 2014.

Exhibit 9. Traders Hold Record Bullish Oil Price Bet



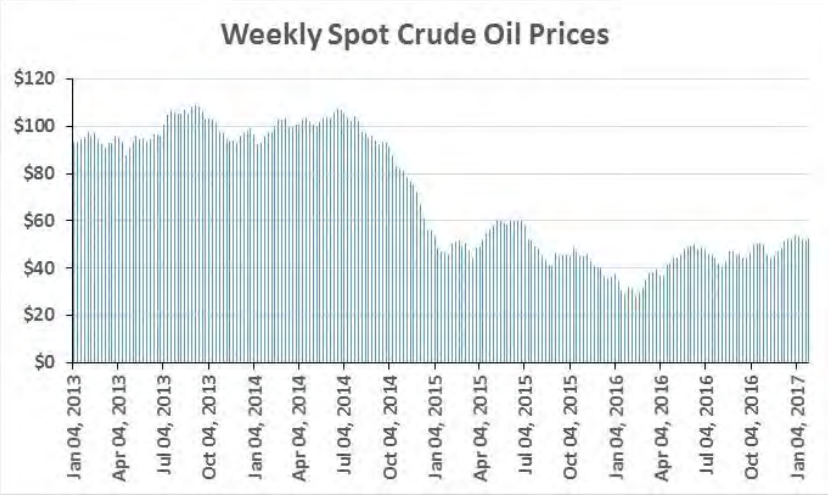
Source: ***The Wall Street Journal***

The meaning of the record long position is interesting, based on the history of this data series. In Exhibit 10, we have shown the weekly West Texas Intermediate spot oil price for the same period of 2013-

The spot oil price fell either when the holdings were reported, or immediately thereafter

2017. It shows that in 2013 and 2014, each time the traders built to record bullish oil contract holdings, oil prices were peaking and subsequently declined. At that time, the peak in spot oil prices peaked in 2013, and nearly returned to that peak in the middle of 2014. But the important point is that the spot oil price fell either when the holdings were reported, or immediately thereafter. Is there a cause and effect evident from this correlation or is it merely a coincidence? In 2013 and 2014, the peak holdings and oil price were reflective of high levels of industry and trader optimism for even higher oil prices in the future. While one might argue that between the 2013 and 2014 peaks, traders made money by holding their long contracts, the profit generated was small, and the reality is that in shorter measurement periods traders lost money.

Exhibit 10. Oil Prices Have Fallen After Bullish Bets



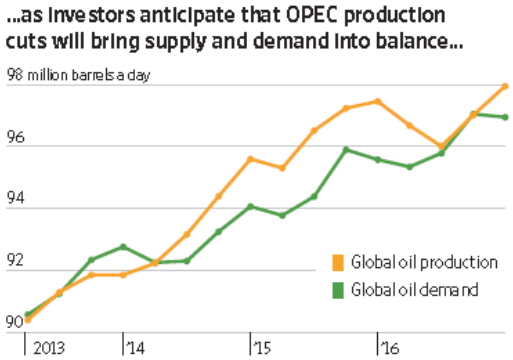
Source: EIA, PPHB

That situation would rapidly eat into the global oil glut reflected by the record one billion barrels of current world oil inventories

What is driving oil price optimism now is the belief that OPEC and Russia, its key ally in the effort to stabilize the global crude oil market, are being successful in cutting their production flows. This success is reflected in the chart of the outlook for the global crude oil market from the International Energy Agency (IEA) that calls for supply and demand to reach equilibrium by mid-2017. That would support current oil prices and potentially push them higher if forecasts in the future show that global oil supplies will fall below demand. That situation would rapidly eat into the global oil glut reflected by the record one billion barrels of current world oil inventories, the condition keeping oil prices from rising higher since the November 2016 OPEC oil production reduction agreement.

The key to a decline in world inventory levels will be faster economic growth from the United States and the world's developed economies coupled with continued high growth from developing countries. Importantly, the energy industry also needs to see the growth in oil output globally limited if the market rebalancing is to be successful

Exhibit 11. Oil Supply/Demand Come Together



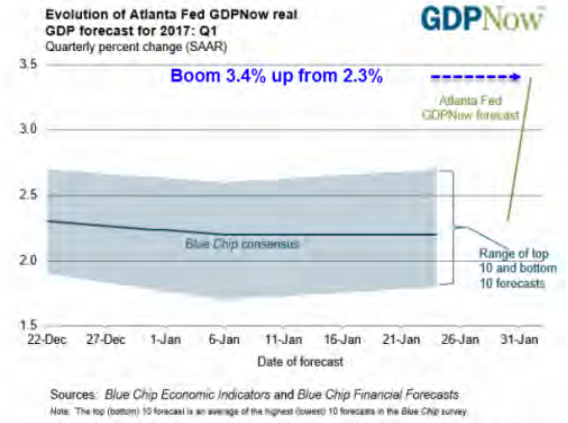
Source: ***The Wall Street Journal***

on a sustained basis. So what does the latest economic and industry data show and how are forecasts shaping up?

The Atlanta Federal Reserve Bank's GDPNow forecasting model upped its annualized estimate for first quarter 2017 gross domestic production to 3.4% from its prior estimate of 2.3%

On the economic front, at least on the surface, data appears to be supportive of faster economic growth. After the latest reports for personal consumption expenditures, real private fixed investment and the Institute for Supply Management's Purchasing Managers' index, the Atlanta Federal Reserve Bank's GDPNow forecasting model upped its annualized estimate for first quarter 2017 gross domestic production to 3.4% from its prior estimate of 2.3%. This is well above the range and median estimates of the Blue Chip Economic Survey along with the projections of Charles Evans, president of the Chicago Federal Reserve Bank and a member of the Federal Open Market Committee, who suggested U.S. economic growth would be in the 2%-2.5% per year range for the next few years. Mr. Evans' forecast is consistent with the outlook for the economy set forth by Federal Reserve Chairman Janet Yellen last week in her statement following the latest FOMC meeting when the Federal Reserve Bank decided to leave interest rates unchanged in the target range of 0.5%-0.75%.

Exhibit 12. Atlanta Fed Has Jumped Its 1Q17 GDP Estimate



Source: ***MishTalk***

A financial economist posted the GDPNow chart (Exhibit 12, prior page) in a column Friday in which he said he would take the "under" bet on the 3.4% growth projection when actual first quarter growth is reported later in the year.

He pointed out that the stock market, the financial analysts and the media are "gaga" over the "headline" employment number, but totally ignoring the underlying data trends

Last Friday, the Bureau of Labor Statistics reported that job growth in January soared to 227,000 new jobs created versus analysts' estimates for only 175,000 jobs. It also reported that the percentage of the available labor force now working also increased. Below the surface, however, the data was not as supportive. The same financial economist posted a chart of employment in the United States along with a list of current data that has him concerned about the health of the economy. He pointed out that the stock market, the financial analysts and the media are "gaga" over the "headline" employment number, but totally ignoring the underlying data trends. He was referring to trends showing that employment over the past three months has only increased by 33,000, or 11,000 per month on average. For the past year, employment average grew by 129,000 per month, but since March 2016 it only increased by an average of 78,000 per month. January 2017's actual employment fell by 30,000. If job growth is waning, what does that mean for future economic growth?

The latest auto sales numbers for January were hailed as positive as the seasonally adjusted annual rate of new vehicle sales hit 17.57 million units

The latest auto sales numbers for January were hailed as positive as the seasonally adjusted annual rate (SAAR) of new vehicle sales hit 17.57 million units. That rate was down slightly from December's 17.62 million SAAR when the industry was pushing units out the door with aggressive sale incentives and promotional pricing. With sales slowing and inventories growing, auto makers are already talking about having to institute production holidays, meaning plant shutdowns and layoffs.

Exhibit 13. Headline Jobs Number Overlooks Problems

Source: ***MishTalk***

The oil minister of Saudi Arabia stated that OPEC and its partners, including Russia, have already cut more than 80% of the 1.8 million barrels a day reduction goal

From the oil market's point of view, prices have been buoyed by estimates from various oil shipping trackers that OPEC and Russian tracking shows greater compliance with their production cut targets than has been the case historically. The oil minister of Saudi Arabia stated that OPEC and its partners, including Russia, have already cut more than 80% of the 1.8 million barrels a day reduction goal. Petro-Logistics SA reported that the 11 members of OPEC with production targets covered by the output agreement have reduced their combined volume by 900,000 barrels a day, or by 75%.

Reuters reported that based on its survey of the OPEC members' January output, volumes have been reduced by one million barrels a day of the 1.2 million barrel target, or an 82% compliance. All of these compliance percentages are well above the historical 66% rate for OPEC over the past three decades.

Outside of these countries, all eyes in the oil patch are on the United States where the improvement in oil prices is rapidly translating into increased drilling activity and higher oil output

The concern for oil prices is not only OPEC and Russian output, but that of OPEC member countries exempt from the Vienna production agreement. Iran, which has been recovering from its economic sanctions, was allowed to boost its output back to a level closer to the pre-sanction level, or nearly 90,000 barrels a day increase, while Libya and Nigeria, where production has been hampered by unrest, have been exempted entirely. Outside of these countries, all eyes in the oil patch are on the United States where the improvement in oil prices is rapidly translating into increased drilling activity and higher oil output.

Since the OPEC agreement was reached on November 30, 2016, the total U.S. rig count has jumped by 22%

Since the OPEC agreement was reached on November 30, 2016, the total U.S. rig count has jumped by 22% through last Friday, or an increase of 132 active rigs. Of that increase, 106 of the additional rigs are seeking oil targets, or 80% of the increase. The pace of rig additions has accelerated in recent weeks with last week seeing 17 more active rigs after the prior two weeks adding 18 and 35 rigs working, respectively. In terms of oil rigs added in the past three weeks, all of the active rig fleet gain last week was oil-related while the prior two weeks saw 15 of 18 and 29 of 35 rigs added targeting oil prospects.

While that was down about 300,000 barrels a day from production a year-ago, it is 40,000 barrels a day higher than the average output reported for November

The impact of the upturn in drilling has been a boost to U.S. oil output, and especially for tight oil, which is where the additional rigs are working. The four-week average domestic oil production estimated by the EIA as of January 27th was 8.942 million barrels a day. While that was down about 300,000 barrels a day from production a year-ago, it is 40,000 barrels a day higher than the average output reported for November, the last verifiable production figure reported by the EIA.

The range of oil production this year is very wide and confounds the assessment of its meaning for oil exports and the global oil market

At the present time, the concern in marketplace is what happens to U.S. oil production this year and potentially oil exports, and how that outlook might fit with global oil output. The range of oil production this year is very wide and confounds the assessment of its meaning for oil exports and the global oil market. Investment firm Macquarie Capital (USA) sees annual output reaching 9.37 million barrels a day, while oil consultants Turner, Mason & Co. and Lipow Oil Associates LLC each put it around 9 million barrels a day. Consultant Wood Mackenzie forecasts a more-conservative output of 8.75 million barrels a day.

For the first 11 months of 2016, according to the EIA, the U.S. exported 527,000 barrels a day. Based on the estimates of the four firms above, it is possible that the U.S. could average 800,000

Speculating about domestic oil output is also a chancy endeavor.

barrels a day of crude oil exports this year, offsetting much of the reduced output engineered by OPEC and its partners, assuming they can hold their production down for the full year. Based on the cheating record of OPEC members and the other countries presently allied with OPEC, assuming a full year of production cut compliance is not a safe bet. On the other hand, speculating about domestic oil output is also a chancy endeavor.

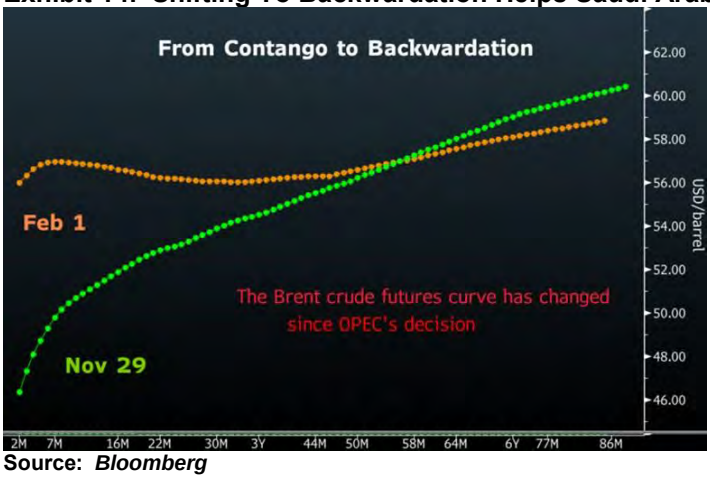
He also sees them only reaching $58-$60 a barrel, at which point they will be capped by market forces

If Vikas Dwivedi, a senior analyst at Macquarie is correct in his view that "Godzilla is even taller in person," oil prices may struggle to stay at current levels later in the year. He suggests that "U.S. production will be bigger than most people are expecting." At the same time, an oil trader who specializes in technical analysis for predicting oil prices says prices will continue to rise. But, he also sees them only reaching $58-$60 a barrel, at which point they will be capped by market forces. From today's roughly $54 a barrel level, that move would generate a healthy profit for those traders who are currently long oil contracts.

A weaker U.S. dollar has also helped oil prices in recent days

What we know about oil prices at the moment is that they are being helped by the Trump administration's move to institute new economic sanctions on Iran for testing another intercontinental ballistic missile in violation of the terms of the nuclear deal negotiated with the Obama administration. This announcement has boosted slightly the risk premium portion of world oil prices. A weaker U.S. dollar has also helped oil prices in recent days. But possibly the greatest impact on oil prices has been the successful efforts of Saudi Arabia and OPEC to reshape the oil price curve from contango to backwardation.

Exhibit 14. Shifting To Backwardation Helps Saudi Arabia



Source: ***Bloomberg***

Prior to OPEC's Vienna Agreement last November, putting oil in storage because of its higher future value was a strong motivation for growing storage volumes. Now the curve is much flatter, and for oil priced three years in the future, that price is lower than the

"The oil futures curve is indicating that the current OPEC cuts are here to stay for a while"

current one, providing a strong disincentive for putting oil in storage. Backwardation plays a significant role in oil producers' decisions to hedge their production since they risk the potential of the price moving higher if the more traditional contango environment returns. As Rob Thummel, a managing director and portfolio manager at Tortoise Capital Advisors LLC put it, "What happens to the curve does depend on how the OPEC cuts will be carried out. The oil futures curve is indicating that the current OPEC cuts are here to stay for a while." U.S. oil producers will be very happy if that proves to be the case. While history would suggest otherwise, the pending (early 2018) initial public offering for Saudi Arabia's state oil company, Saudi Aramco, an important component of its domestic economic restructuring effort, might force the country to hold its output down much longer than it has indicated. The reality may be that hundreds of small U.S. oil producers may screw up Saudi Arabia's grand plan while hurting speculating oil traders with their record bullish oil price bet. A lower future oil price after a record bullish oil futures bet would be consistent with our recent history.

Natural Gas, Nuclear Power And The Future Of The Grid

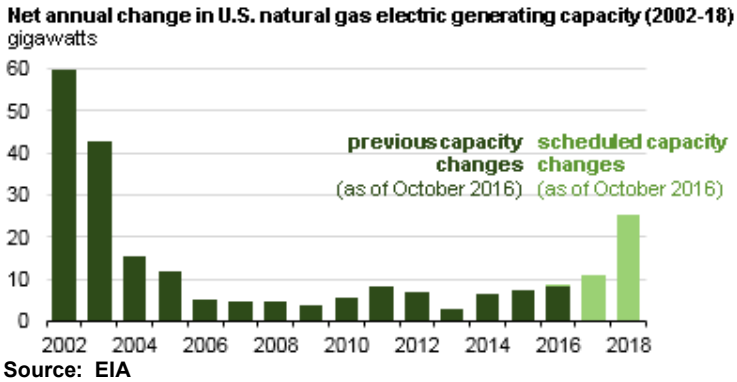
The role of natural gas in the electric power business suggesting it will grow

The Energy Information Administration (EIA) recently posted a brief analysis of the role of natural gas in the electric power business suggesting it will grow. While that would appear to be the case in the immediate future, the analysis may be overlooking several dynamics at work within both the natural gas industry as well as the utility business, which could alter the EIA's outlook in the out years of any forecast.

That should be good news for gas producers who will be looking toward future demand increases

In reviewing the EIA's analysis, the first chart (Exhibit 15) shows how scheduled natural gas electric generating capacity additions for 2017 and 2018 are greater than at any time in the past decade. That should be good news for gas producers who will be looking toward future demand increases. Coupled with the emergence of the domestic liquefied natural gas (LNG) business, natural gas output is rising and helping lift gas prices and boost drilling activity.

Exhibit 15. Natural Gas Power Capacity To Grow



Source: EIA

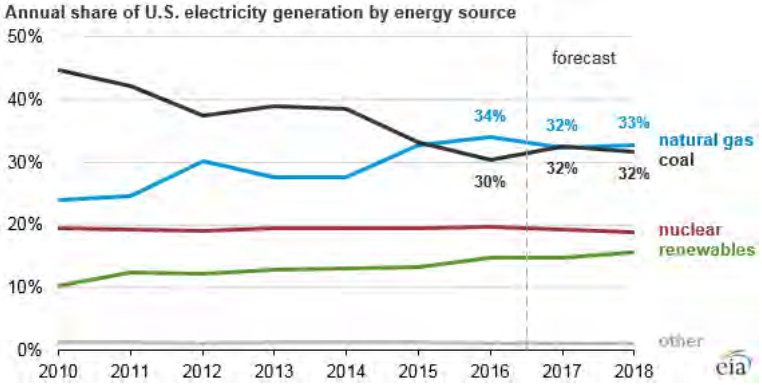
Natural gas surpassed coal during 2014 as the largest energy source for generating electricity

The EIA also produced a chart (Exhibit 16) that shows the relative share of U.S. electricity generation by fuel source over the past six years along with the agency's forecast for 2017 and 2018. What the chart shows is that natural gas surpassed coal during 2014 as the largest energy source for generating electricity and has remained in that role through the latest data available as of the third quarter of 2016. The EIA's forecast calls for natural gas to be tied with coal in 2017 for share of electricity generation but edge ahead during 2018.

After years of essentially a steady 20% market share, nuclear is beginning to trend down

The other observations from the chart is that after years of essentially a steady 20% market share, nuclear is beginning to trend down reflecting the decisions of utilities to shutter some of their oldest plants. At the same time, the percentage of electricity generated from renewables continues to increase as these fuels become more cost-competitive with fossil fuels and due to increased government mandates for utilities to use more renewables, regardless of the economics for utility customers.

Exhibit 16. Nuclear Power's Share Slowly Falling



Source: EIA

If all these new natural gas generating plants were to be completed, they would represent 16% of greenhouse gas emissions from electricity

So why might the EIA's forecast be at risk? One of the major problems is the growing pushback by environmental groups over increased natural gas use. An article published in *Time* magazine last week, in which the Sierra Club, a leading environmental group, highlighted a new report showing that if all these new natural gas generating plants were to be completed, they would represent 16% of greenhouse gas emissions from the electric sector.

As natural gas has pushed coal out of the power generation market, its economics have also begun to impact nuclear power plants

The report was the result of a yearlong effort to get more coal-fired power plants retired. That effort has been helped by the low price for natural gas that has largely made coal-fired power generation more expensive. But as natural gas has pushed coal out of the power generation market, its economics have also begun to impact nuclear power plants. The bigger problem for natural gas is that due to its low cost, the fuel has now become a target of the environment movement. As Michael Brune, executive director of the Sierra Club put it, "Gas is part of the problem and not part of the solution. And it's just as vulnerable as coal."

Environmentalists, who once championed natural gas as the environmentally-friendly fuel due to it possessing half the amount of carbon per pound of coal, now believe that they have underestimated the amount of methane that escapes into the atmosphere through leaks

According to the Sierra Club report, and consistent with the EIA data, 31 gigawatts of gas generating capacity is currently under construction in the United States with another 111 gigawatts of capacity proposed. Some 9,000 miles of gas pipelines also remain in the proposal phase. Environmentalists, who once championed natural gas as the environmentally-friendly fuel due to it possessing half the amount of carbon per pound of coal, now believe that they have underestimated the amount of methane that escapes into the atmosphere through leaks. Methane is reportedly 25 times more potent a greenhouse gas compared to carbon dioxide over a 100 year period according to the Environmental Protection Agency. However, CO2 lasts for hundreds of years in the atmosphere while methane has a life of about 12 years. But, as environmental research has shown, the various estimates of the volume of methane coming from leaking valves associated with the oil and gas industry and power plants is small compared to the volume released by nature from wetlands.

The effort to build one new mile of pipeline can be halted by protests, punishing lenders and investors besides the owners of the pipelines

What the environmental lobby has discovered in recent years is that trying to fight the oil and gas industry is much more difficult than motivating people to obstruct the building of new pipelines necessary to move natural gas from producing wells to consumers. Thus, despite the existence of thousands of miles of pipelines crisscrossing various regions, the effort to build one new mile of pipeline can be halted by protests, punishing lenders and investors besides the owners of the pipelines.

The low gas price has spurred the fuel's growth for generating electricity and undercut the use of coal, and now nuclear, but more importantly the economics of renewables for generating power

In general, the increased opposition to natural gas, which was once viewed as the "bridge fuel" to a lower-carbon and cleaner environment, has come less from the sudden discovery that gas still releases carbon emissions than the realization that its price has fallen to a fraction of what it was when gas was the darling fuel of environmentalists. The low gas price has spurred the fuel's growth for generating electricity and undercut the use of coal, and now nuclear, but more importantly the economics of renewables for generating power. Don't forget that nuclear is also a carbonless emissions energy fuel. Also at issue in this battle over natural gas' future as a power source is the question of the operation of the grid.

The major advantage of nuclear power is that the plants operate at about a 93% efficiency rate, meaning they are the steadiest source of power for the grids

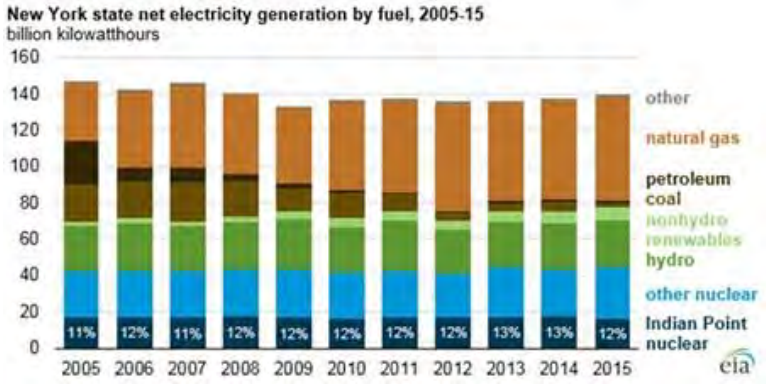
Although nuclear power only accounts for about 20% of our electricity generation nationwide, in various states where the plants are located, it is a more important source of power. The major advantage of nuclear power is that the plants operate at about a 93% efficiency rate, meaning they are the steadiest source of power for the grids the plants are connected to. This is becoming an important issue as the share of renewable power grows, given its high intermittency factor. The latest test for nuclear power is coming in New York State where Governor Andrew Cuomo (Dem) has negotiated a deal to get the owner of the Indian Point nuclear plant to close it down by 2021, some 14 years ahead of the end of its current license period. The 2,083 megawatt power plant's reactors

came on line in 1973 and 1974, respectively. When their original licenses ended in 2013 and 2014, the owner, Entergy Corporation (ETR-NYSE) filed for 30-year extensions, but now they will be closed early.

Nuclear power's generation capacity represents only 5 gigawatts of the state's 40 gigawatts of total power generating capacity, or roughly 12.5%, much less than its actual contribution to the power supply in New York State

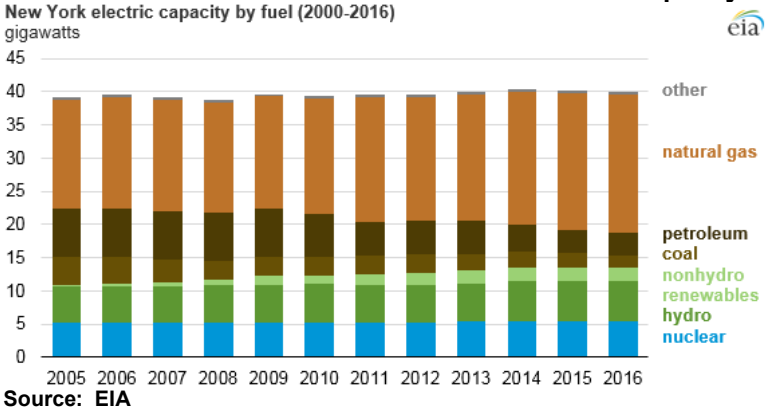
The Indian Point plant is located about 30 miles north of New York City. It contains two reactors and provides New York City and neighboring Westchester County with about a quarter of its electricity, and has been for decades. Overall, the plant accounts for 12% of New York State's power consumption while nuclear overall provides approximately 40% of the state's next electricity generation. As noted in Exhibit 17, nuclear power's generation capacity represents only 5 gigawatts of the state's 40 gigawatts of total power generating capacity, or roughly 12.5%, much less than its actual contribution to the power supply in New York State, something that seems to be overlooked in Gov. Cuomo's rush to create a green energy future for the state.

Exhibit 17. Indian Point Is Key Power Supply Contributor



Source: EIA

Exhibit 18. Nuclear Power Contributes Above Its Capacity



Source: EIA

The plant has been considered a safety hazard by Gov. Cuomo for a number of years, and he has targeted its closure for some time.

New York will provide $7.6 billion in subsidies to keep them operating

Alternatively, Gov. Cuomo has worked to develop a subsidy program for three older upstate New York nuclear power plants. Under the program he has developed, New York will provide $7.6 billion in subsidies to keep them operating. The political calculus is that Gov. Cuomo is opting in favor of keeping jobs and energy upstate, while promoting safety and environmental concerns downstate.

Gov. Cuomo is promoting a plan for New York State to reach 50% of its electricity being generated from "green" sources including wind, solar and other renewables including imported Canadian hydropower

Gov. Cuomo is working to burnish his environmental credentials for a re-election bid and potentially as a Democratic presidential candidate in 2020. He has led an effort to ban fracturing technology statewide due to issues of safety with drinking water. Of course, that ban has hurt some upstate regions where natural gas deposits are located and cannot be developed. At the same time, Gov. Cuomo is promoting a plan for New York State to reach 50% of its electricity being generated from "green" sources including wind, solar and other renewables including imported Canadian hydropower. As part of the green energy plan to be released by the end of 2017, Gov. Cuomo is promoting offshore wind in the Atlantic Ocean as an important component.

The wind farm's output is estimated to provide 3.75% of the overall offshore wind energy goal of 2,400 megawatts by 2030 that forms a core of Gov. Cuomo's green energy plan

Recently, a 90-megawatt wind farm to be located in an Atlantic Ocean tract offshore the eastern tip of Long Island was approved by the Board of Trustees of the Long Island Power Authority (LIPA). The project will consist of 15 wind turbines and be located 30 miles southeast of Montauk. It will be developed by Deepwater Wind, the developer of the Block Island Wind Farm located offshore in Rhode Island state waters that recently began operating. It is estimated the Long Island wind farm will cost $740 million, but will be eligible for the federal investment tax credit of 24% of the project's cost. The project still has many hurdles to meet, but the developer is targeting it to be in operation by the end of 2022, which requires construction to start in 2020. The wind farm's output is estimated to provide 3.75% of the total offshore wind energy goal of 2,400 megawatts by 2030 forming the core of Gov. Cuomo's green energy plan.

The average cost of electricity on Long Island is 7.5 cents per kilowatt-hour, so the additional PPA cost will add an estimated $1.19 per month to customer bills for the next 20 years

The discussion between the developer and the LIPA regarding a power purchase agreement (PPA) is for the electricity to be bought for 16 cents per kilowatt-hour, considerably below the 24 cents per kilowatt-hour PPA signed by Rhode Island utility customers. At the present time, the average cost of electricity on Long Island is 7.5 cents per kilowatt-hour, so the additional PPA cost will add an estimated $1.19 per month to customer bills for the next 20 years.

A new natural gas plant has an estimated cost of 5.7 cents per kilowatt-hour

The economics of the wind farm are not attractive relative to those of a nuclear plant or a combined-cycle natural gas power plant. The average production cost for nuclear power is 2.4 cents per kilowatt-hour versus the average cost to build and operate an offshore wind plant in the U.S. of 15.8 cents per kilowatt-hour. A new natural gas plant has an estimated cost of 5.7 cents per kilowatt-hour. For New Yorkers whose electricity rates are already 40% above the national average, they will be facing even higher power costs in the future.

Because nuclear plants operate at 93% efficiency as compared to the 45% efficiency of offshore wind farms, New York will need to build substantially more generating capacity that has higher reliability than that of offshore wind

Those economics do not address the issue of the grid and its reliability. Already, the New York Independent System Operator has said that the closure of the Indian Point nuclear plant will effect reliability of the power grid through 2026 unless there is adequate replacement power. Because nuclear plants operate at 93% efficiency as compared to the 45% efficiency of offshore wind farms, New York will need to build substantially more generating capacity that has higher reliability than that of offshore wind. The reliability of the grid depends on its ability to provide stable voltage as power sources come in and out to meet fluctuating power demands. While the nation's power grids have gotten better at managing the introduction of greater amounts of variable power from intermittent sources such as wind and solar, the backbone of grids are large fossil fuel plants that run efficiently all the time. While offshore wind has a greater reliability rating than onshore wind, it is certain that 45% efficiency doesn't match 93%.

Natural gas is the last barrier to the environmental goal of a totally renewable based power grid – the carbonless electric economy

As coal and nuclear power plants are removed from the U.S. electricity grid, natural gas has become the preferred alternative to insure a stable grid. That important new role is behind why the Sierra Club and other environmental activists have targeted blocking the development of new natural gas pipeline projects. Natural gas is the last barrier to the environmental goal of a totally renewable based power grid – the carbonless electric economy. If victorious in this effort to derail natural gas developments, in the future people may have to check the wind and sun before flicking on their home's electric power switch.

BP Energy Outlook Offers Interesting Views Of The Future

"The main story in this year's Energy Outlook is about the energy transition that is taking place and is likely to continue to take place over the next 20 years"

Recently, BP plc (BP-NYSE) published its 2017 Annual Energy Outlook setting forth the company's view of the future for the world's economy, its energy needs and how those needs are likely to be met. As part of the presentation introducing the report, BP's group energy economist, Spencer Dale, set forth the primary theme of the outlook: "The main story in this year's Energy Outlook is about the energy transition that is taking place and is likely to continue to take place over the next 20 years. On the demand side, there's a shift in the pattern of demand, away from the US and Europe to fast-growing Asian markets. On the supply side, the story is one of a continuing shift in the fuel mix towards lower carbon fuels." Not surprisingly, this theme dominates the conclusions of the outlook, and presumably BP's corporate strategy.

As should not be surprising, BP's energy outlook may not be the same energy outlook others in the industry foresee. In particular, BP's view that the magnitude of recoverable oil available in the world is twice the projected demand for oil between now and 2050 may be considered too liberal a view about the economics of the industry. But since the price to develop these resources was not stated, it is hard to know about the economics. Given BP's view of that potential

supply overhang, the company believes some portion of those global oil reserves will never be produced. The fear of surplus oil reserves being left in the ground will generate, in BP's view, increased competition between companies and producer nations to ensure that as many oil reserves as possible are consumed and not left permanently stranded, especially as the transition from fossil fuels to cleaner renewable energy supplies accelerates. What his means for BP was spelled out by Robert Dudley, the company's CEO. He wrote in the introduction to the report:

In BP's view, increased competition between companies and producer nations to ensure that as many oil reserves as possible are consumed and not left permanently stranded

"The global energy landscape is changing. Traditional centers of demand are being overtaken by fast-growing emerging markets. The energy mix is shifting, driven by technological improvements and environmental concerns. More than ever, our industry needs to adapt to meet those changing energy needs."

Mr. Dudley cited his and his company's view that a carbon tax is the most effective and efficient method for addressing increased carbon pollution

With respect to dealing with one issue facing the changing energy business, carbon emissions, Mr. Dudley cited his and his company's view that a carbon tax is the most effective and efficient method for addressing increased carbon pollution from burning fossil fuels. If structured properly, a carbon tax eliminates the tendency of politicians to structure environmental policies that contort market forces and introduce an aspect of "choosing winners and losers."

BP sees renewables, in conjunction with nuclear and hydroelectric power, providing half the additional energy the world will need by 2035

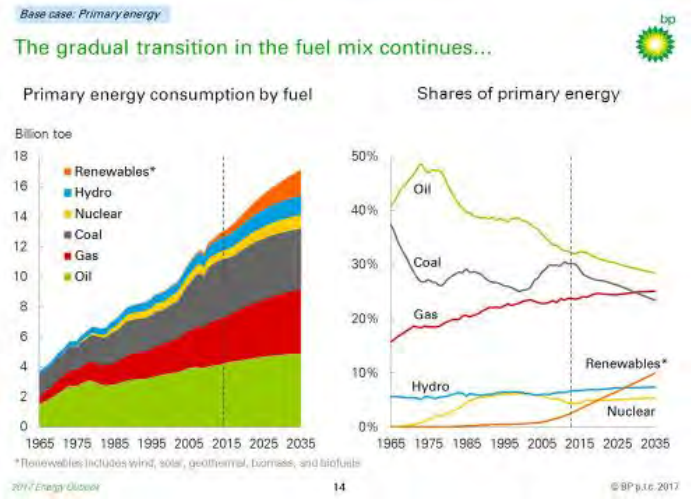
Key points about BP's base case energy outlook include that the world's gross domestic product (GDP) will almost double by 2035, driven by rapidly growing emerging economies and more than two billion people having their living standards raised out of poverty. This rising prosperity will drive increased energy consumption, but due to meaningful improvements in energy efficiency, total energy demand increases by about 30%, or only a third of the economic growth rate. Importantly, BP sees renewables, in conjunction with nuclear and hydroelectric power, providing half the additional energy the world will need by 2035. Fossil fuels – oil, natural gas and coal - will continue to be the dominant sources of energy in meeting the world's future needs. But as BP showed in one slide, only natural gas and renewables see their share of global energy increase in the future. Two other low carbon fuels – hydropower and nuclear – show essentially stable energy market shares.

The global LNG market becomes anchored by U.S. gas prices, which will alter the economics of newly proposed gas export projects around the world

Natural gas will play a significant role in the energy supplies for the future. Its role grows faster than that for crude oil and coal, primarily because of the success of the U.S. shale revolution. That growing supply of natural gas will further alter the global gas market as U.S. exports in the form of liquefied natural gas (LNG) helps integrate the global gas market. Importantly, the global LNG market becomes anchored by U.S. gas prices, which will alter the economics of newly proposed gas export projects around the world.

The global oil market will also see significant change over the next 20 years as the pace of demand growth slows. In BP's view, all of

Exhibit 19. The World's Energy Supply Mix Shifts



Source: BP

The growth of the world's auto fleet will boost gasoline consumption by four million barrels per day

the oil demand growth will come from emerging markets, with China accounting for half that growth. Two-thirds of the oil demand growth comes from the transportation sector as there will likely be a doubling of the global car fleet from 900 million vehicles to 1.8 billion by 2035. The growth of the world's auto fleet will boost gasoline consumption by four million barrels per day. The growth rate would be greater except for the fact that improved vehicle fuel efficiency coupled with autonomous vehicles, car sharing and ride-pooling efforts will limit the increase. In addition, the fuel consumption growth rate will be limited by the significant growth in the number of electric cars on the roads. Between now and 2035, BP projects that the number of electric vehicles will grow from 1.2 million in 2015 to 100 million in 2035, representing roughly 5% of the global vehicle fleet at that point.

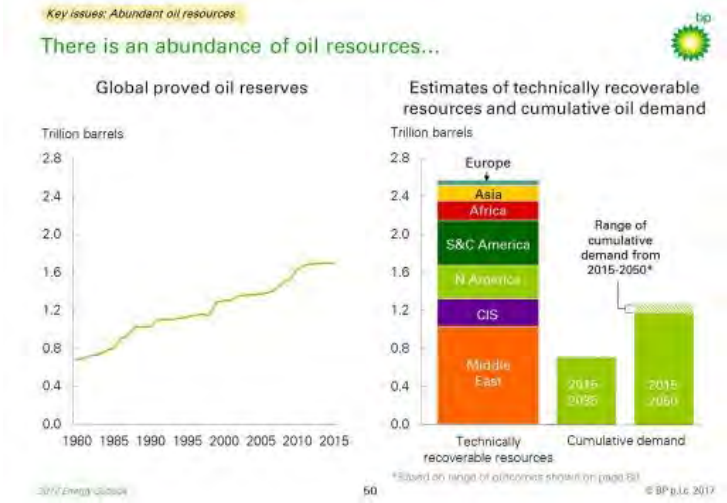
"The impact of electric cars, together with other aspects of the mobility revolution, such as self-driving cars, car sharing and ride pooling, is one of the key uncertainties surrounding the long-term outlook for oil"

The variables impacting the composition of the world's vehicle fleet and how vehicles are used increase the challenge in forecasting oil consumption. As Mr. Dale explained the issue, "The impact of electric cars, together with other aspects of the mobility revolution, such as self-driving cars, car sharing and ride pooling, is one of the key uncertainties surrounding the long-term outlook for oil." It is the reason why BP's economists decided to develop alternative scenarios for the impact of electric vehicles on oil consumption. In the base case, the world's automobile fleet becomes 5% electrified. How significant will that be in limiting gasoline consumption? What if the electrified percentage goes meaningfully higher? On the other hand, the base case plays a role in how greater electrification of the global energy market will impact future energy supplies.

The interplay of broad energy policy questions on the shape of future energy markets and fuel supplies is what we find most fascinating about the BP energy outlook. In the case of increased

electrification of the global economy, the issue wades into the question of the changing utility business model and the rapid growth of renewables in an effort to decarbonize the world's energy system.

Exhibit 20. Will Current Resources Stay In The Ground?



Source: BP

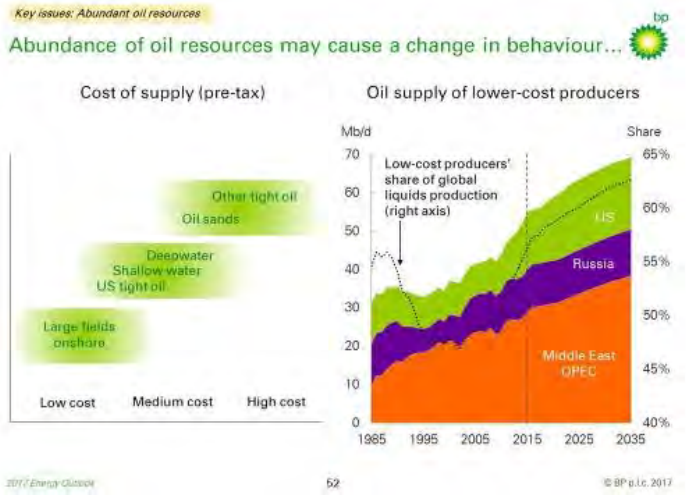
There was a flattening in that growth rate during 2010-2015, despite oil prices spending much of the time above $100 a barrel

Returning to the issue of an oversupply of global oil altering the market, two slides in BP's outlook introduction presentation sum up the company's view. The first slide showed two graphs. The left hand graph showed the growth of proved oil reserves over the past 35 years. Notably, there was a flattening in that growth rate during 2010-2015, despite oil prices spending much of the time above $100 a barrel. The more significant right-hand graph showed the geographic location of the world's technically recoverable resources. The important point is the relationship between the proved reserves in 2015 compared to the technically recoverable resources. Additionally, it is important to compare the cumulative oil demand for 2015-2035, and even for the maximum demand for 2015-2050 that show only a portion of potential resources. The second BP slide brings these relationships into focus.

A growing share of the world's oil production will be captured by these low-cost producers

While BP categorizes the global oil resources – onshore fields, U.S. tight oil, shallow water, deepwater, oil sands and other tight oil – by whether they are low, medium or high cost, the graph on the right shows where the low-cost oil resources are located. It also shows how a growing share of the world's oil production will be captured by these low-cost producers. With their share growing from about 56% now to 63% in 2035, BP believes oil price competition will remain intense and limit how high oil prices can (will) rise in the future. This is the key assumption in Mr. Dudley's mantra of the past two years about oil prices being "lower for longer." Whether prices stay low, and just how low they might stay, will depend on several considerations BP spelled out. "The extent to which global supply behavior changes is a key source of uncertainty and depends on: (i)

Exhibit 21. How Cost Of Resources Determines Winners



Source: BP

the cost and feasibility of low-cost producers increasing supply materially over the Outlook; (ii) the extent to which prices respond to increased supplies of low-cost oil and the implications this has for producers' economies; and (iii) the ability of higher-cost producers to compete by varying their tax and royalty regimes." How each of these variables, or a combination of them, plays out in the future will ultimately determine how low oil prices remain and for how long.

Not everyone does, or will, agree with BP's view of the energy future

Not everyone does, or will, agree with BP's view of the energy future. What we know, however, is that this outlook is shaping BP's corporate strategy, so we should not be surprised that the company will only pursue low-cost energy project developments and eventually will become increasingly involved in ways to capitalize on the shifts in energy supply and demand it sees on the horizon. Whether BP's view proves correct, only time will tell. BP's outlook does provide an interesting viewpoint about the future that everyone involved in the energy industry should consider, especially what it means for their strategies if BP's view becomes reality.

<u>Correction:</u> In the last *Musings* we incorrectly identified the first U.S. energy czar who was Bill Simon who previously worked for Bill Solomon at the investment firm of Solomon Bros. in the 1960s.

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